NASA/DoD Aerospace Knowledge Diffusion Research Project

Paper Six

Aerospace Knowledge Diffusion in the Academic Community: A Report of Phase 3 Activities of the NASA/DoD Aerospace Knowledge Diffusion Research Project

Paper Presented at the 1990 Annual Conference of the American Society for Engineering Education Engineering Libraries Division Toronto, Canada June 27, 1990

Thomas E. Pinelli
NASA Langley Research Center
Hampton, Virginia

John M. Kennedy
Indiana University
Bloomington, Indiana

NASA
National Aeronautics and Space Administration

Department of Defense

INDIANA UNIVERSITY

INTRODUCTION

Although the U.S. aerospace industry continues to be the leading positive contributor to the balance of trade among all merchandise industries, it is experiencing significant changes whose implications may not be well understood.[1] Increasing U.S. collaboration with foreign producers will result in a more international manufacturing environment, which will allow for a more rapid diffusion of technology, increasing pressure on U.S. aerospace companies to push forward with new technological developments, and to take steps designed to maximize the inclusion of recent technological developments into the research and development (R&D) process.

To remain a world leader in aerospace, the U.S. must take the steps necessary to improve and maintain the professional competency of aerospace engineers and scientists, and enhance innovation and productivity. How well these objectives are met, and at what cost, depends on a variety of factors, but largely on the ability of aerospace engineers and scientists to acquire and process the results of NASA/DoD funded R&D.

The ability of U.S. aerospace engineers and scientists to identify, acquire, and use scientific and technical information (STI) is of paramount importance to the efficiency of the R&D process. Testimony to the central role of STI in the R&D process is found in numerous studies (Fischer, 1980). These studies show, among other things, that U.S. aerospace engineers and scientists devote more time, on the average, to the communication of technical information than to any other scientific or technical activity (Pinelli, et al., 1989). We concur, therefore, with Fischer's (1980) conclusion that the "role of scientific and technical communication is thus central to the success of the innovation process, in general, and the management of R&D activities, in particular."

The **NASA/DoD Aerospace Knowledge Diffusion Research Project** was developed because, in terms of empirically derived data, very little is known about the diffusion of knowledge in the aerospace industry both in terms of the channels used to communicate the ideas and the information-gathering habits and practices of the members of the social system (i.e., aerospace engineers and scientists). Even less is known about the system through which the results of federally-funded aerospace R&D is diffused throughout the aerospace community. Understanding how STI is communicated through certain channels over time among members of the social system would contribute to increasing productivity, stimulating innovation, and improving and maintaining the professional competence of U.S. aerospace engineers and scientists.

---

[1] "Aerospace" includes aeronautics, space science, space technology, and related fields.

PROJECT OVERVIEW

The **NASA/DoD Aerospace Knowledge Diffusion Research Project** is a cooperative effort that is sponsored by NASA, Codes RF and NTT, and the DoD, Office of the Assistant Secretary of the Air Force, Deputy for Scientific and Technical Information. The research project is a joint effort of the Indiana University Center for Survey Research and the NASA Langley Research Center.

The project will provide descriptive and analytical data regarding the flow of STI at the individual, organizational, national, and international levels. It will examine both the channels used to communicate information and the social system of the aerospace knowledge diffusion process. The results of the project should provide useful information to R&D managers, information managers, and others concerned with improving access to and use of STI.

Several major barriers to effective knowledge diffusion exist in the U.S. **First,** the very low level of monetary support for knowledge transfer compared with knowledge production suggests that dissemination efforts are not viewed as an important component of the R&D process. **Second,** there are mounting reports from users about difficulties in getting appropriate information useful for problem solving and decision making. **Third,** rapid advances in many areas of STI knowledge can be fully exploited only if they are quickly translated into further research and application. **Fourth,** current mechanisms are often inadequate to help the user assess the quality of available information. **Fifth,** the characteristics of actual usage behavior are not considered in making available useful and easily retrieved information.

These deficiencies must be remedied if the results of federally funded R&D are to be successfully applied to innovation, problem solving, and productivity. Only by maximizing the R&D process can the U.S. maintain its international competitive edge in aerospace.

Project Assumptions

1. Rapid diffusion of technology and technological developments requires an understanding of the aerospace knowledge diffusion process.

2. Knowledge production, transfer, and utilization are equally important components of the aerospace knowledge diffusion process.

3. Understanding the channels; the information products involved in the production, transfer, and utilization of aerospace information; and the information-seeking habits, practices, and preferences of aerospace engineers and scientists is necessary to understand aerospace knowledge diffusion.

4. The knowledge derived from federally funded aerospace R&D is indispensable in maintaining the vitality and international competitiveness of the U.S.

aerospace industry and essential in maintaining and improving the professional competency of U.S. aerospace engineers and scientists.

5. The U.S. government technical report plays an important, but as yet undefined, role in the transfer and utilization of knowledge derived from federally funded aerospace R&D.

6. Librarians, as information intermediaries, play an important, but as yet undefined, role in the transfer and utilization of knowledge derived from federally funded aerospace R&D.

Project Objectives

1. Understanding the aerospace knowledge diffusion process at the individual, organizational, and national levels, placing particular emphasis on the diffusion of federally funded aerospace STI.

2. Understanding the international aerospace knowledge diffusion process at the individual and organizational levels, placing particular emphasis on the systems used to diffuse the results of federally funded aerospace STI.

3. Understanding the roles NASA/DoD technical reports and aerospace librarians play in the transfer and utilization of knowledge derived from federally funded aerospace R&D.

4. Achieving recognition and acceptance within NASA, DoD and throughout the aerospace community that STI is a valuable strategic resource for innovation, problem solving, and productivity.

5. Providing results that can be used to optimize the effectiveness and efficiency of the Federal STI aerospace transfer system and exchange mechanism.

Project Design

The initial thrust of the aerospace knowledge diffusion research project is largely exploratory and descriptive; it focuses on the information channels and the members of the social system associated with the Federal aerospace knowledge diffusion process. It provides a pragmatic basis for understanding how the results of NASA/DoD research diffuse into the aerospace R&D process. Over the long term, the project will provide an empirical basis for understanding the aerospace knowledge diffusion process at the individual, organizational, national, and international levels. An outline of the descriptive portion of the project is contained in Table 1 as "A Five Year Program of Research on Aerospace Knowledge Diffusion."

Table 1. A Five Year Program of Research on Aerospace Knowledge Diffusion

	Phase 1 1989-1991	Phase 2 1990-1992	Phase 3 1990-1991	Phase 4 1991-1994
Level	•National •Individuals •U.S. Aerospace Engineers and Scientists	•National •Individuals and Organizations •Aerospace librarians in gov't and industry •U.S. gov't and aerospace industries	•National •Individuals and Organizations •U.S. academic faculty, students, and engineering libraries	•International •Individuals and Organizations
Focus	•Knowledge production and use	•Knowledge transfer and use	•Knowledge transfer and use	•Knowledge production, transfer, and use
Emphasis	•Use, importance, and production of NASA/DOD STI (e.g., technical reports) •Impediments to access, transfer, and use of NASA/DOD STI •Use and importance of AGARD and non-U.S. STI •Use and importance of information technology •Information sources used in problem solving	•Use, importance, and production of NASA/DOD STI (e.g., technical reports) •Impediments to access, transfer, and use of NASA/DOD STI •Use and importance of AGARD and non-U.S. STI •Use and importance of information technology •Effectiveness of system used to transfer U.S. gov't funded STI	•Use, importance, and production of NASA/DOD STI (e.g., technical reports) •Impediments to access, transfer, and use of NASA/DOD STI •Use and importance of AGARD and non-U.S. STI •Use and importance of information technology •Effectiveness of system used to transfer U.S. gov't funded STI	•Use and importance of NASA/DOD STI •Use of AGARD and non-U.S. STI •Impediments to access, transfer, and use of aerospace STI •Use of information technology •System used to transfer results of gov't funded aerospace STI non-U.S. aerospace STI, and systems, policies, and practices
Subjects	•AIAA membership •SAE membership	•U.S. aerospace librarians in gov't and industry •Selected U.S. gov't facilities and aerospace companies	•U.S. aerospace faculty, academic engineering libraries, and U.S. aerospace students (seniors) in USRA capstone design courses	•RAeS •DGLR •JSASS •aerospace faculties and students •aerospace librarians
Method	•Pilot study •Self-administered mail questionnaires •Telephone follow-ups	•Self-administered mail questionnaires •Personal interviews •Telephone follow-ups	•Self-administered mail questionnaires •Personal interviews •Telephone follow-ups	•Pilot study •Self-administered mail questionnaires
Desired Outcomes	•Understanding of individual information-seeking behaviors of U.S. aerospace engineers and scientists •Explain use/non-use of U.S. gov't funded STI products and services by U.S. aerospace engineers and scientists	•Understanding of the internal flow of aerospace STI in gov't and industry •Understanding of the system used to transfer results of U.S. gov't funded aerospace STI	•Understanding of the internal flow of aerospace STI in academia •Understanding of the system used to transfer results of U.S. gov't funded aerospace STI	•Understanding of individual information-seeking behavior •Understanding of the system used to transfer results of gov't funded aerospace STI •Understanding of non-U.S. aerospace STI systems, policies, and practices

Phase 1 of the 4-phase project is concerned with the information-seeking habits and practices of U.S. aerospace engineers and scientists, with particular emphasis being placed on their use of federally funded aerospace STI products and services. The conceptual model shown in figure 1 assumes a consistent internal logic that governs the information-seeking and processing behavior of aerospace engineers and scientists despite any individual differences they may exhibit.

The results of the **Phase 1 Pilot Study** indicate that U.S. aerospace engineers and scientists spend approximately 65 percent of a 40-hour work week communicating STI. The types of information and the information products used and produced in performing professional duties are similar, with basic STI and in-house technical data most frequently reported. **Internal** STI to the organization, which includes NASA/DoD technical reports, journal articles, and conference/ meeting papers is preferred over **external** STI. Respondents identified informal channels and personalized sources as the primary methods of seeking STI, followed by the use of formal information sources when solving technical problems. Only after completing an informal search, followed by using formal information sources, do they turn to librarians and technical information specialists for assistance.

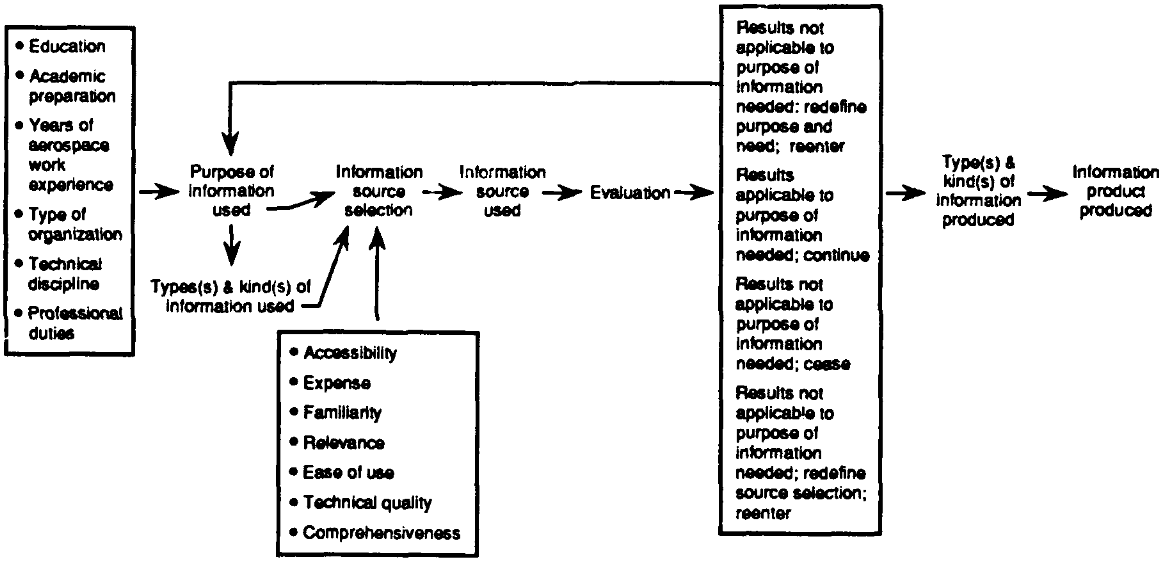

Figure 1. A Conceptual Model for the Use, Transfer, and Production of STI by U.S. Aerospace Engineers and Scientists

Phase 2 focuses on aerospace knowledge transfer and use within the larger social system, placing particular emphasis on the flow of aerospace STI in government and industry and the role of the information intermediary (i.e., the aerospace librarian/technical information specialist) in knowledge transfer. In Phase 2, the process of innovation in the U.S. aerospace industry is conceptualized as an information processing system which must deal with work-related uncertainty through patterns of technical communications. Information processing in aerospace R&D (figure 2) is viewed as an ongoing problem solving cycle involving each activity within the innovation process, the larger organization, and the external world.

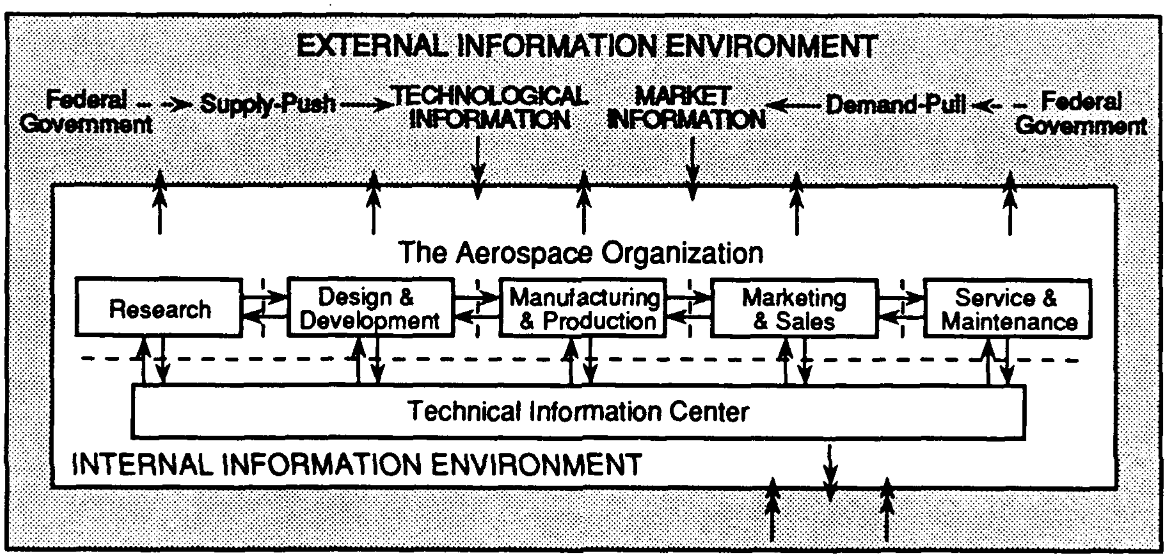

Figure 2. The Aerospace R&D Process as an Information Processing System.

Phase 3 focuses on knowledge use and transfer at the individual and organizational levels in the academic sector of the aerospace community. Faced with shrinking enrollments, particularly at the graduate level, university aerospace programs must find ways to maintain the talent pool that will advance aerospace technological development and guarantee U.S. competitiveness.

Phase 4 examines knowledge production, use, and transfer among non-U.S. individuals and aerospace organizations, specifically in Western Europe and Japan. As U.S. collaboration with foreign aerospace technology producers increases, a more international manufacturing environment will arise, fostering an increased flow of U.S. trade. To cooperate in joint ventures as well as to compete successfully at the international level, U.S. aerospace industries will need to develop methods to collect, translate, analyze, and disseminate the best of foreign aerospace STI.

OVERVIEW OF THE FEDERAL AEROSPACE KNOWLEDGE DIFFUSION PROCESS

A model (figure 3) that depicts the transfer of federally funded aerospace R&D from "producer to user" is composed of two parts -- the **informal** that relies on collegial contacts and the **formal** that relies on surrogates, information products, and information intermediaries to complete the transfer process.

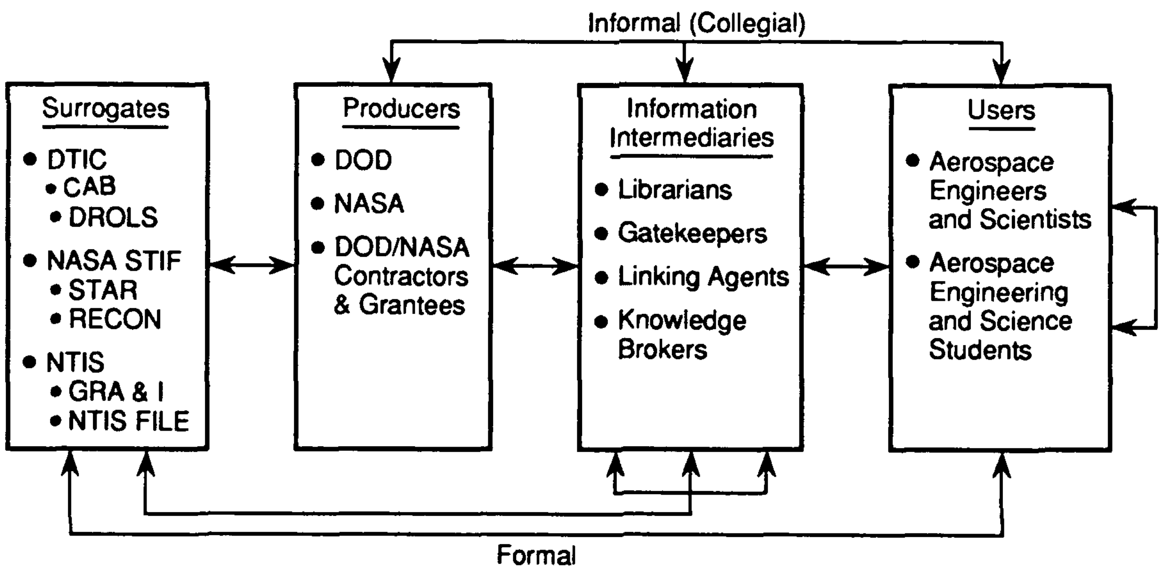

Figure 3. A Model Depicting the Transfer of Federally Funded Aerospace R&D.

Surrogates serve as technical report repositories or clearinghouses for the producers and include the Defense Technical Information Center (DTIC), the NASA Scientific and Technical Information Facility (NASA STIF), and the National Technical Information Service (NTIS). These surrogates have created a variety of technical report announcement journals such as TRAC (Technical Report Announcement Circular) and

STAR (Scientific and Technical Aerospace Reports) and computerized retrieval systems such as DROLS (Defense RDT&E Online System) and RECON (REmote CONsole) that permit online access to technical report databases.

The producers are NASA and the DoD and their contractors and grantees. Producers depend upon surrogates and information intermediaries to complete the knowledge transfer process. When U.S. government technical reports are published, the initial or primary distribution is made to libraries and technical information centers. Copies are sent to surrogates for secondary and subsequent distribution. A limited number are set aside to be used by the author for the "scientist-to-scientist" exchange of information at the individual level.

Information intermediaries are, in large part, librarians and technical information specialists in academia, government, and industry. Information intermediaries represent the producers and serve as what McGowan and Loveless (1981) describe as "knowledge brokers" or "linking agents." The more "active" the intermediary, the more effective the transfer process becomes (Goldhar and Lund, 1985). Active intermediaries take information from one place and move it to another, often face-to-face. Passive information intermediaries, on the other hand, "simply array information for the taking, relying on the initiative of the user to request or search out the information that may be needed" (Eveland, 1987).

Two problems exist with the **formal** part of the system. First, the **formal** part of the system uses one-way producer-to-user transmission. The problem with this kind of transmission is that such formal one-way "supply side" transfer procedures do not seem to be responsive to the user context (Bikson, et al., 1984). Second, the **formal** part relies heavily on information intermediaries to complete the knowledge transfer process. Empirical findings on the effectiveness of information intermediaries and the role(s) they play in knowledge transfer are sparse and inconclusive.

The problem with the **informal** part of the system is that users can learn from collegial contacts only what those contacts happen to know. Ample evidence supports the claim that no one researcher can know about or keep up with all of the research in his/her area(s) of interest. Like other members of the scientific community, aerospace engineers and scientists are faced with the problem of too much information to know about, to keep up with, and to screen -- information that is becoming more interdisciplinary in nature and more international in scope.

PHASE 3 PRELIMINARY RESULTS

Phase 3 of the NASA/DoD Aerospace Knowledge Diffusion Project is concerned with the information-seeking habits, practices and attitudes of U.S. aerospace engineering and science students and faculty. In addition, it seeks to determine the kind of and the extent to which students and faculty receive education and training in the use of information sources. The primary goal of this phase is to answer the

question: "Are the information-seeking habits, practices and attitudes of aerospace engineering and science students unique such that they may demand special consideration by federal aerospace STI producers?"

Phase 3 respondents were information intermediaries (librarians), aerospace engineering faculty and undergraduate engineering students. Questionnaires were sent to each group as part of Phase 3. This presentation is a discussion of preliminary results from two surveys. Because the results are preliminary, readers should be careful when interpreting the data. The first survey was conducted with a sample of aerospace science and engineering faculty. The questionnaire asked faculty about their use of various sources of technical information and their opinions about the importance of and familiarity with these sources. Students enrolled in University Space Research Association (USRA) Capstone Design courses were the second group surveyed. This group was asked about their use of various sources of technical information and instruction they have received on how to use such sources. The faculty and students were asked similar questions.

The American Society of Engineering Educators (ASEE) provided a list of schools in the U.S. with aerospace departments or programs. Along with aerospace engineering, these departments included aeronautical engineering, mechanical engineering and astronautical engineering programs. The list included a contact person (usually the department chairman) who was called by CSR. The contacts were asked to provide a list of department faculty. This master list was compared to the list of respondents contacted earlier in Phase 1 of this project. Any faculty member previously surveyed was deleted from the list and the remaining faculty members were sent questionnaires.

The USRA provided the CSR with a list of 44 faculty members who taught the capstone design course funded by the USRA. Telephone calls to these faculty members eliminated 5 who were not eligible and solicited participation in the study from the rest. Each faculty member was asked to administer the questionnaire to students enrolled in the capstone course and return the completed questionnaires to CSR.

The data presented are preliminary results from 589 students and 235 faculty. U.S. aerospace faculty and students were asked which information products they frequently used to meet their engineering needs. Each product was scored on a five point scale with "1" designated as frequently used and "5" as never used. The first graph reflects the percent of respondents choosing one or two on the scale. As shown in figure 4, faculty members used journal articles more than students. Eighty percent of faculty members and 52 percent of students cited journal articles as a "1" or "2". Students used NASA technical reports more often than faculty members. Forty-nine percent of students and 39 percent of faculty reported using NASA technical reports frequently to meet engineering information needs. The remaining three products were used more often by faculty than by students to meet their engineering information needs. DoD technical reports and foreign technical reports were more frequently used by faculty.

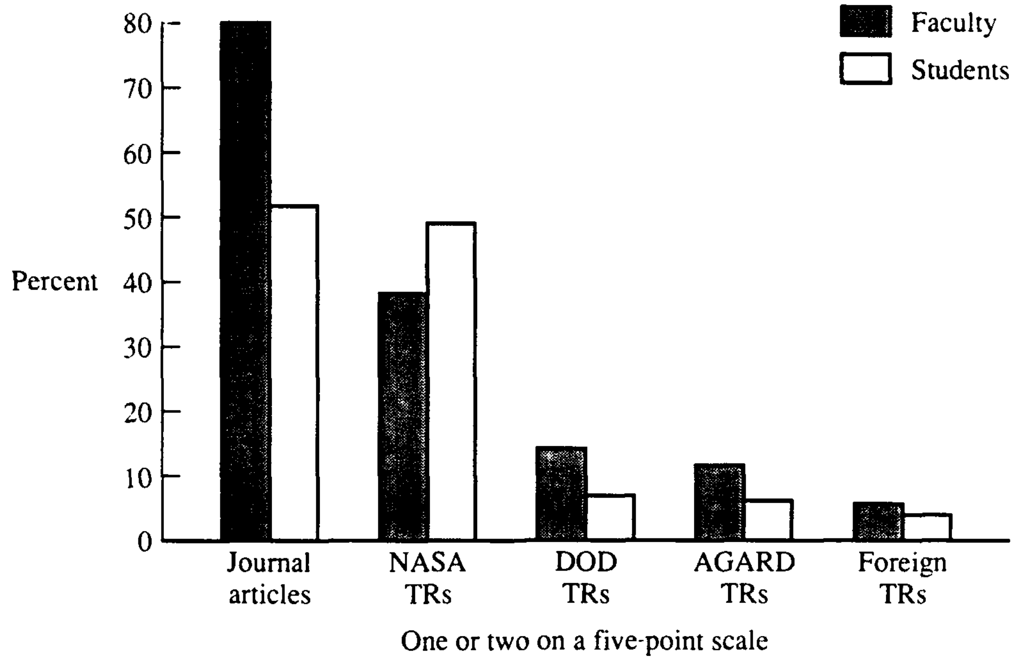

Figure 4. Use of Information Products by U.S. Aerospace Faculty and Students.

The students and faculty were asked to rate the importance of these same information products on a five point scale. Figure 5 shows that faculty rated journal articles highest. Eighty-eight percent rated them as a "1" or "2" and 58 percent of

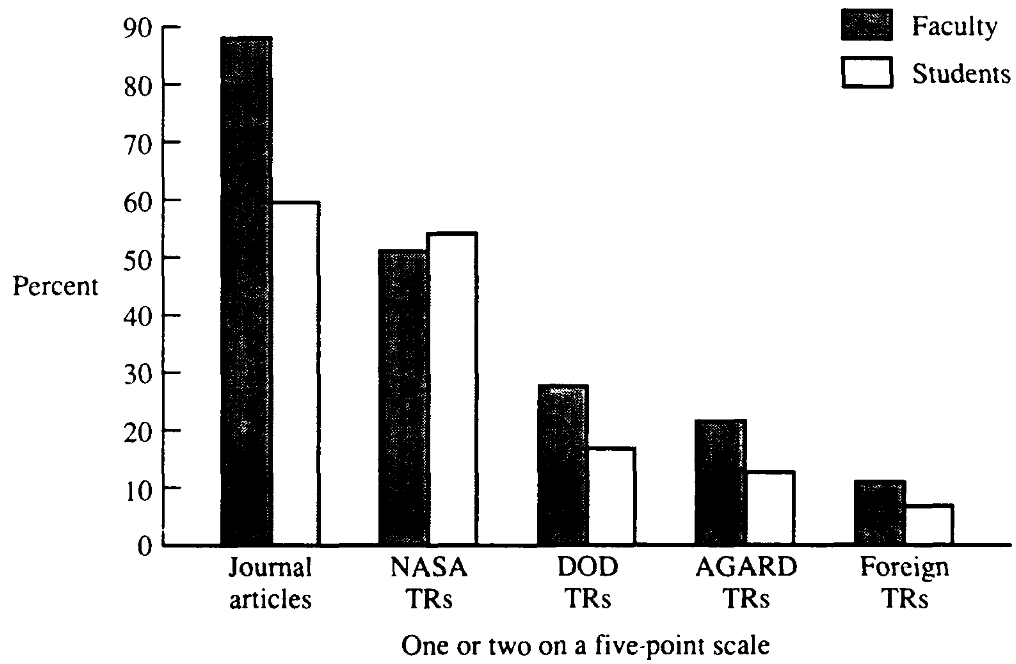

Figure 5. Importance of Information Products by U.S. Aerospace Faculty and Students.

students chose "1" or "2". NASA technical reports were rated about equally by both faculty and students (54 percent, 51 percent). A higher percentage of faculty (27 percent) rated DoD reports important than did students (16 percent). Faculty also considered AGARD reports (21 percent) and foreign technical reports (10 percent) to be more important than did students (12 percent and 6 percent, respectively).

Engineering students were asked a series of questions about courses or instruction they might have received as preparation to become an engineer (figure 6).

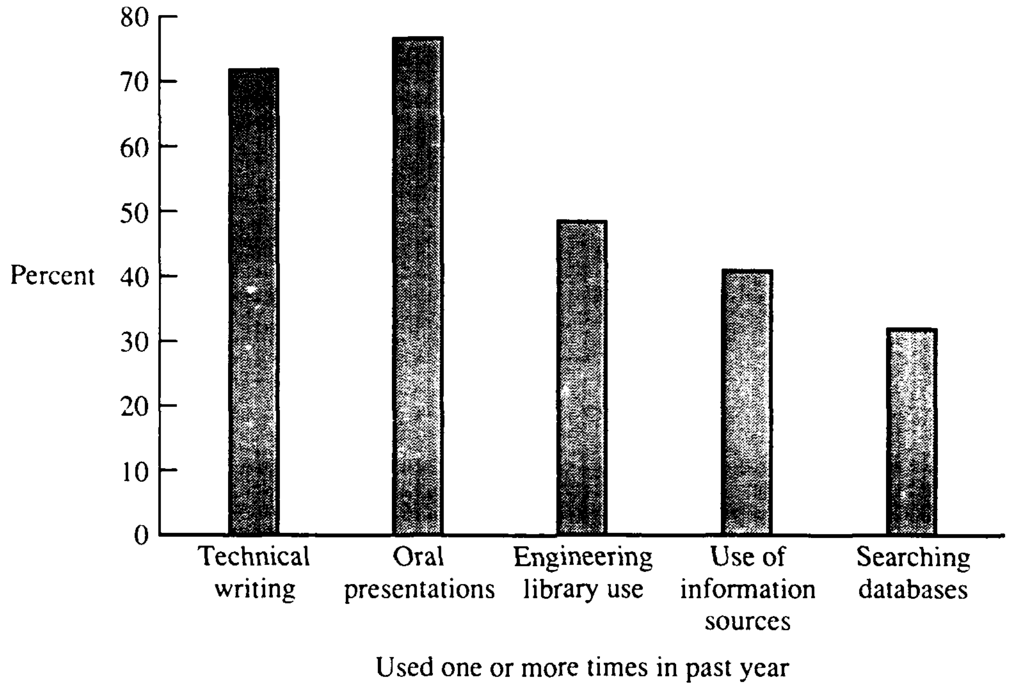

Figure 6. Instruction Received by U.S. Aerospace Students.

Instruction in making oral presentations was received by 77 percent of the students; 73 percent had instruction in technical writing; and 49 percent received instruction in how to use the engineering or departmental library. Only 40 percent of the students had instruction in engineering information resources and materials. Instruction in searching online electronic databases was given to 31 percent of engineering students surveyed.

The faculty and students were asked to rate (on a five point scale) the importance of two factors that could affect the professional success of engineering students -- (1) the ability to communicate technical information effectively and (2) an understanding and knowledge of engineering resources/materials (figure 7).

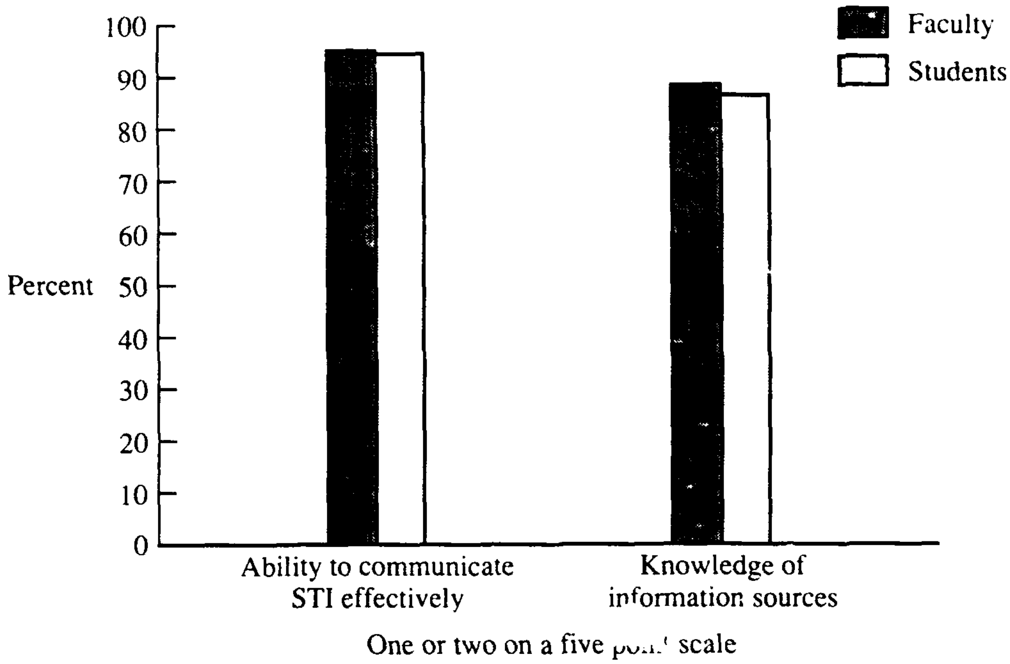

Figure 7. Importance of Two Factors Affecting the Success of Engineering Students.

Most faculty (98 percent) and students (97 percent) rated effective communication of technical information as important. The understanding and knowledge of engineering resources and materials was thought to be important in the professional success of engineering students by about 90 percent of both faculty and students.

Figure 8 shows how often faculty and students selected specific information sources in meeting their engineering information needs. Forty-four percent of faculty and students used university libraries frequently. Thirty-nine percent of faculty and 43 percent of students used the engineering libraries. Twenty-five percent of faculty and ten percent of students used NASA/DoD contacts. Only eight percent of faculty and 12 percent of students used librarians in meeting their engineering needs.

Figure 9 shows the importance of these information sources to U.S. aerospace faculty and students in meeting their engineering information needs. Sixty-five percent of the faculty and 54 percent of the students indicated that the university library is an important information source. A slightly smaller number of faculty (54 percent) and students (55 percent) indicated that the engineering library is an important informtion source. Forty-one percent of the faculty and 23 percent of the students indicated that NASA/DoD contacts are important information sources. About 23 percent of the faculty and 22 percent of the students indicated that librarians are important information sources. These number stand in sharp contrast to percentage of faculty and students who use librarians.

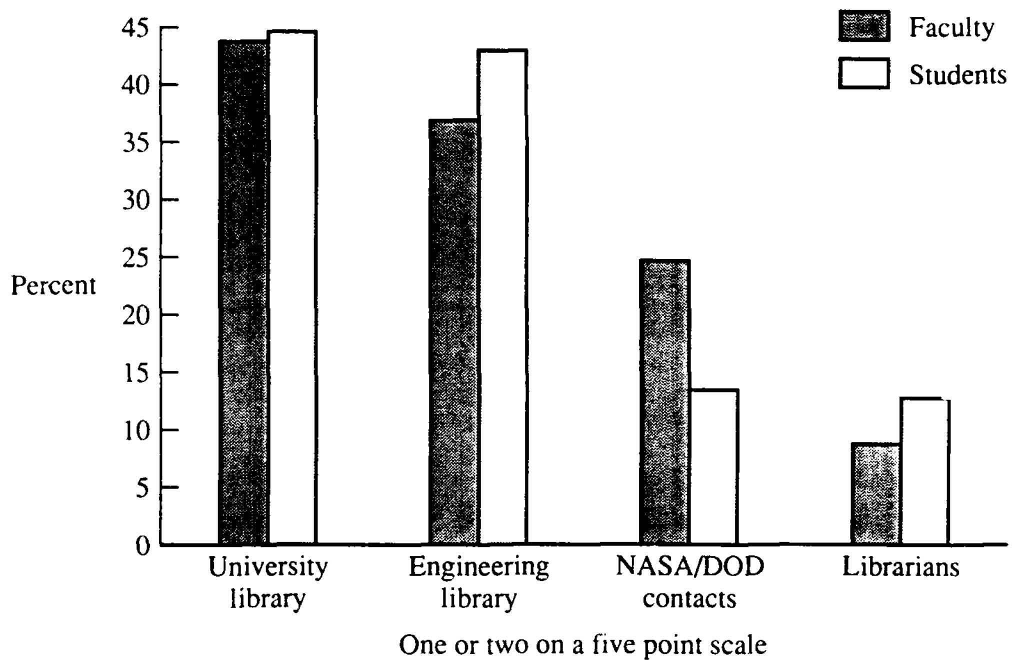

Figure 8. Use of Information Sources by U.S. Aerospace Faculty and Students.

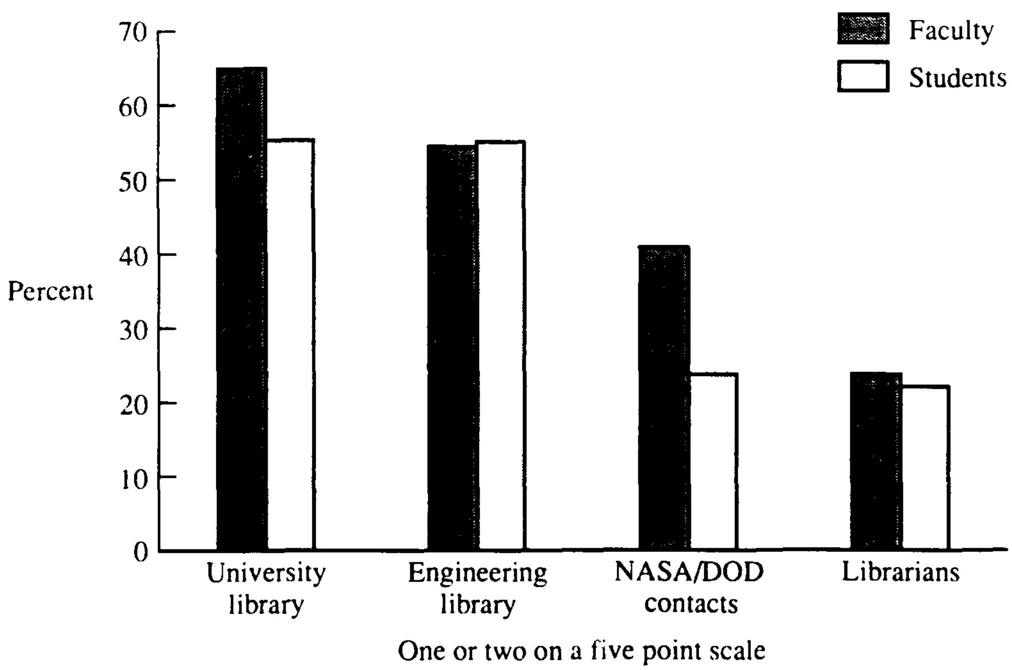

Figure 9. Importance of Information Sources by U.S. Aerospace Engineers and Sceintists.

Engineering faculty and students use computer and information technology in different proportions. Figure 10 shows students use spellcheckers, scientific graphics and electronic databases more often than do faculty. Faculty, however use Fax/Telex and electronic mail more often. This difference is due primarily to the greater access faculty have to the equipment required. The biggest gap between faculty and student use was with spellcheckers. Students used them almost 20 percentage point more often than faculty (84 percent, 64 percent).

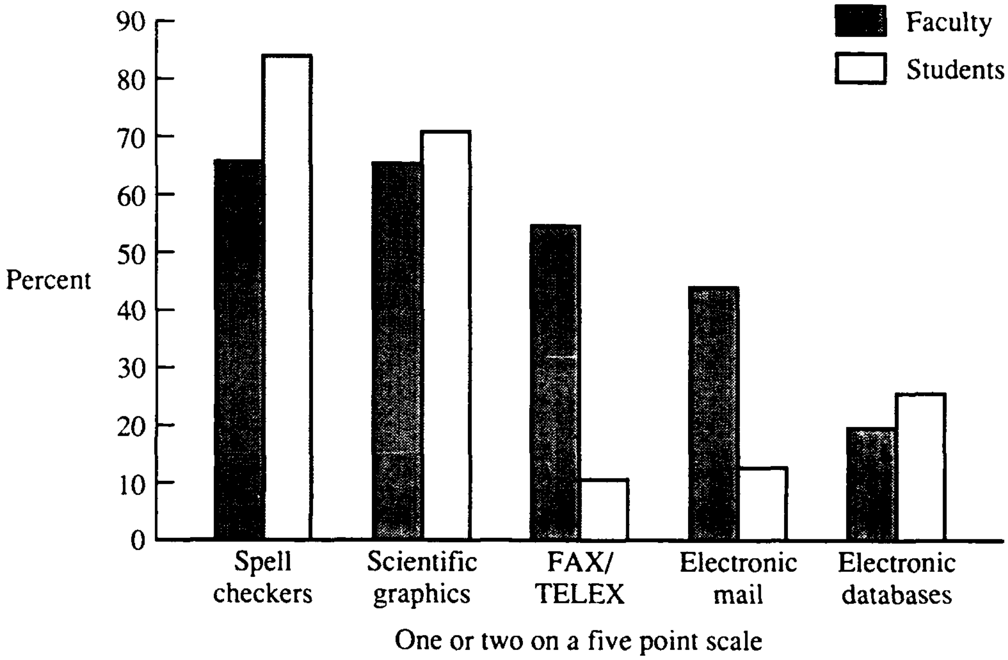

Figure 10. Use of Computer and Information Technology by U.S. Aerospace Engineers and Scientists.

Figure 11 contains data on engineering faculty and students ratings of NASA technical reports on several factors. Students and faculty rated the technical reports about the same in technical quality (70 percent). About 3 percentage points fewer students than faculty (57 percent, 54 percent) rate NASA technical reports as comprehensive. However, when asked about ease of use and accessibility, students feel NASA technical reports are less accessible and more difficult to use than faculty. About ten percentage points fewer students rate NASA technical reports as easy to use (49 percent, 60 percent) and about 15 percentage points fewer students found them to be accessible (36 percent, 50 percent). NASA technical reports are used by students but they have more difficulty with them, especially in gaining access to the reports.

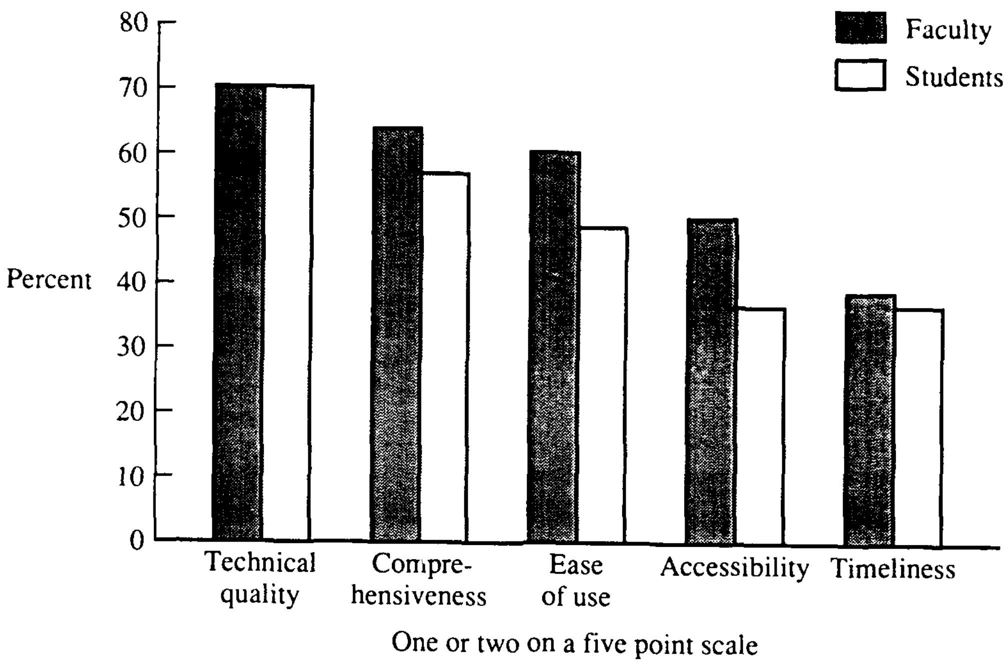

Figure 11. An Assessment of NASA Technical Reports by U.S. Aerospace Engineers and Scientists.

Bibliographic sources were also used at different rates by faculty and students. Figure 12 shows that NASA RECON and NTIS Online are used by more faculty than

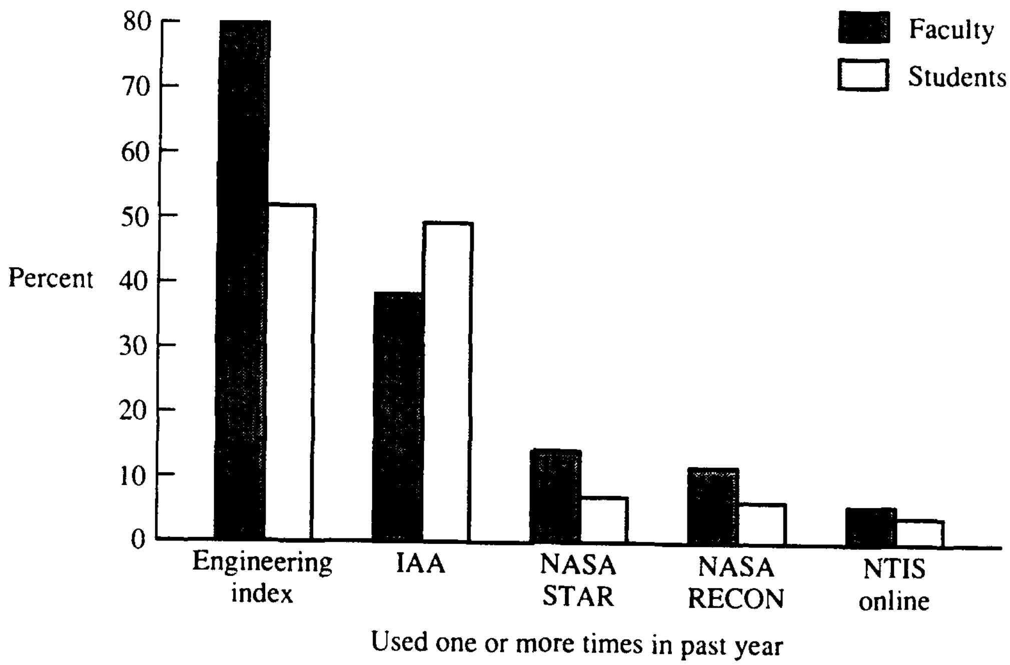

Figure 12. Use of Bibliographic Sources by U.S. Aerospace Engineers and Scientists.

students, but were not used much by either. Fewer than 15 percent of each group reported using any of the online databases during the past school year. Faculty used the Engineering Index more often than students. Forty-three percent had used it in the last school year while only 35 percent of students had. However, students turned to IAA as often as the faculty (35 percent, 35 percent). NASA STAR was used at least once by 19 percent of students and 35 percent of faculty.

CONCLUDING REMARKS

Because the results are preliminary, readers should be careful when interpreting the data. Overall, these data indicate that aerospace engineering faculty and students are frequent users of scientific and technical information (STI). The relative use of STI is related to professional research and classroom assignments. Students in the USRA capstone design courses appear to be relatively heavy users of NASA technical reports.

A large percentage of student receive instruction in technical writing and oral presentations. To a lesser extent, they receive instruction in using the engineering library, information sources, and searching data bases. Both faculty and students indicate that the ability of effectively communicate technical information is important to the professional success of aerospace engineers and scientists. Smaller percentages of faculty and students indicated that knowledge of information sources is important to the professional success of aerospace engineers and scientists.

The use and importance of university and engineering librarians is about the same for faculty and students. The use and importance of NASA/DoD contracts varies somewhat for both groups. Faculty and students rated the importance of librarians high. The use, however, of librarians by faculty and students is fairly low.

NASA technical reports were rated high in terms of technical quality and comprehensiveness. Engineering Index and IAA are used most frequently by faculty and students. It does not appear the bibliographic tools -- STAR, RECON, and NTIS Online -- are used by either faculty or students.

Little is known, in an empirical sense, about the diffusion of knowledge resulting from federally funded aerospace R&D and the academic community. Faced with shrinking enrollments, particularly at the graduate level, university aerospace programs must find ways to maintain the talent pool that will advance aerospace technological development and guarantee U.S. competitiveness. To prepare future aerospace engineers and scientists, academic programs must have access to "state of the art" STI. Consequently, NASA and the DoD must ensure the effective and efficient delivery of Federally funded aerospace STI. An understanding of individual information-seeking behavior, the flow of aerospace STI, and the STI transfer system in academia should provide NASA/DoD with important insights for program development.

The primary goal of Phase 3 is to answer the question: "Are the information-seeking habits, practices and attitudes of aerospace engineering and science students unique such that they may demand special consideration by federal aerospace STI producers?" The preliminary results suggest the answer is "yes." These findings will be subjected to further analysis.

REFERENCES CITED

Fischer, William A. "Scientific and Technical Information and the Performance of R&D Groups" in Management of Research and Innovation. Burton V. Dean and Joel L. Goldhar eds. (NY: North-Holland Publishing Company, 1980), 67-89.

Pinelli, Thomas E.; Myron Glassman; Walter E. Oliu; and Rebecca O. Barclay. Technical Communications in Aeronautics: Results of an Exploratory Study. Washington, DC: National Aeronautics and Space Administration. NASA TM-101534, **Report 1, Part 1**. February 1989, 106 p. (Available from NTIS, Springfield, VA; 89N26772.)

Dr. John M. Kennedy
Center for Survey Research
Indiana University
1022 East Third Street
Bloomington, IN 47401
(812) 855-2573
(812) 855-2818 FAX

Dr. Thomas E. Pinelli
Mail Stop 180A
NASA Langley Research Center
Hampton, VA 23665-5225
(804) 864-2491
(804) 864-6131 FAX

NASA/DoD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT PUBLICATIONS

Reports

Pinelli, Thomas E.; Myron Glassman; Walter E. Oliu; and Rebecca O. Barclay. **Technical Communications in Aeronautics: Results of an Exploratory Study.** Washington, DC: National Aeronautics and Space Administration. NASA TM-101534, **Report 1, Part 1**. February 1989. 106 p. (Available from NTIS, Springfield, VA; 89N26772.)

Pinelli, Thomas E.; Myron Glassman; Walter E. Oliu; and Rebecca O. Barclay. **Technical Communications in Aeronautics: Results of an Exploratory Study.** Washington, DC: National Aeronautics and Space Administration. NASA TM-101534, **Report 1, Part 2**. February 1989. 84 p. (Available from NTIS, Springfield, VA; 89N26773.)

Pinelli, Thomas E.; Myron Glassman; Rebecca O. Barclay; and Walter E. Oliu. **Technical Communications in Aeronautics: Results of an Exploratory Study -- An Analysis of Managers' and Nonmanagers' Responses.** Washington, DC: National Aeronautics and Space Administration. NASA TM-101625, **Report 2**. August 1989. 58 p. (Available from NTIS, Springfield, VA; 90N11647.)

Pinelli, Thomas E.; Myron Glassman; Rebecca O. Barclay; and Walter E. Oliu. **Technical Communications in Aeronautics: Results of an Exploratory Study -- An Analysis of Profit Managers' and Nonprofit Managers' Responses.** Washington, DC: National Aeronautics and Space Administration. NASA TM-101626, **Report 3**. October 1989. 71 p. (Available from NTIS, Springfield, VA; 90N15848.)

Pinelli, Thomas E.; John M. Kennedy; and Terry F. White. **Summary Report to Phase 1 Respondents**. Washington, DC: National Aeronautics and Space Administration. NASA TM-102772, **Report 4**. January 1991. (Available from NTIS, Springfield, VA.)

Pinelli, Thomas E.; John M. Kennedy; and Terry F. White. **Summary Report to Phase 1 Respondents Including Frequency Distributions**. Washington, DC: National Aeronautics and Space Administration. NASA TM-102773, **Report 5**. January 1991. (Available from NTIS, Springfield, VA.)

Pinelli, Thomas E. **The Relationship Between the Use of U.S. Government Technical Reports by U.S. Aerospace Engineers and Scientists and Selected Institutional and Sociometric Variables**. Washington, DC: National Aeronautics and Space Administration. NASA TM-102774, **Report 6**. January 1991. 350 p. (Available from NTIS, Springfield, VA.)

Papers

Pinelli, Thomas E.; Myron Glassman; Rebecca O. Barclay; and Walter E. Oliu. **The Value of Scientific and Technical Information (STI), Its Relationship to Research and Development (R&D), and Its Use by U.S. Aerospace Engineers and Scientists. Paper 1.** Paper presented at the European Forum "External Information: A Decision Tool" 19 January 1990, Strasbourg, France.

Blados, Walter R.; Thomas E. Pinelli; John M. Kennedy; and Rebecca O. Barclay. **External Information Sources and Aerospace R&D: The Use and Importance of Technical Reports by U.S. Aerospace Engineers and Scientists. Paper 2.** Paper prepared for the 68th AGARD National Delegates Board Meeting, 29 March 1990, Toulouse, France.

Kennedy, John M. and Thomas E. Pinelli. **The Impact of a Sponsor Letter on Mail Survey Response Rates. Paper 3.** Paper presented at the Annual Meeting of the American Association for Public Opinion Research, Lancaster, PA, May 19, 1990.

Pinelli, Thomas E. and John M. Kennedy. **Aerospace Librarians and Technical Information Specialists as Information Intermediaries: A Report of Phase 2 Activities of the NASA/DoD Aerospace Knowledge Diffusion Research Project. Paper 4.** Paper presented at the Special Libraries Association, Aerospace Division - 81st Annual Conference, Pittsburgh, PA, June 13, 1990.

Pinelli, Thomas E.; Rebecca O. Barclay; John M. Kennedy; and Myron Glassman. **Technical Communications in Aerospace: An Analysis of the Practices Reported by U.S. and European Aerospace Engineers and Scientists. Paper 5.** Paper presented at the International Professional Communication Conference (IPCC), Post House Hotel, Guilford, England, September 14, 1990.

Pinelli, Thomas E. and John M. Kennedy. **Aerospace Knowledge Diffusion in the Academic Community: A Report of Phase 3 Activities of the NASA/DoD Aerospace Knowledge Diffusion Research Project. Paper 6.** Paper presented at the 1990 Annual Conference of the American Society for Engineering Education - Engineering Libraries Division, Toronto, Canada, June 27, 1990.

Pinelli, Thomas E. and John M. Kennedy. **The NASA/DoD Aerospace Knowledge Diffusion research Project: The DoD Perspective." Paper 7.** Paper presented at the Defense Technical Information Center (DTIC) 1990 Annual Users Training Conference, Alexandria, VA, November 1, 1990.